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AB469 AB470 AB473 AB475 AB477 AB479 AB48X
AB481 AB519 AB52Y AB531 AB533 AB535 AB537
AB539 AB549 AB559 AB610 AB613 AB616 AB619
AB62X AB621 AB624 AB627 AB630 AB633 AB66X
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None

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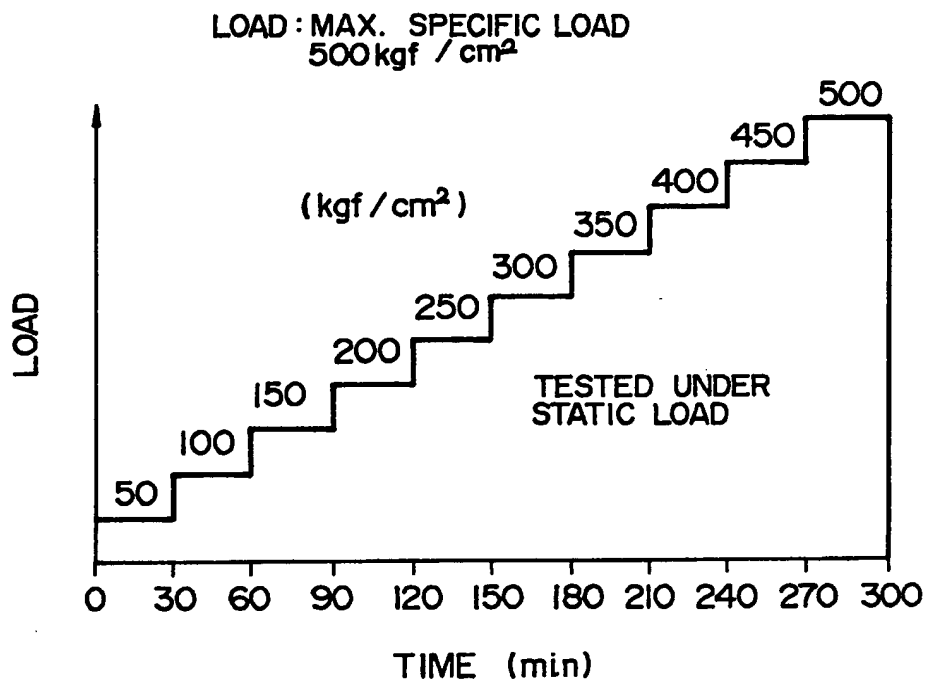
INT CL⁶ C22C

(54) **Bearings**

(57) A copper based alloy, suitable for use in a bearing, is disclosed that can have improved resistance, wear resistance and corrosion resistance. The copper alloy comprises from 1.0 to 3.5 wt% Mn, 0.3 to 1.5 wt% Si, 1 to 25 wt% Zn, 5 to 18 wt% Pb, the balance being substantially Cu (and any incidental impurities). The lead is uniformly distributed throughout the structure of the alloy. The alloy has a microstructure whose matrix is composed of α -phase alone. The alloy can further contain at least one alloy metal from 0.02 to 1.5 wt% Mg or 0.1 to 1.5 wt% Te and one of 0.5 to 3.0 wt% Ni or 0.3 to 3.0 wt% Al.

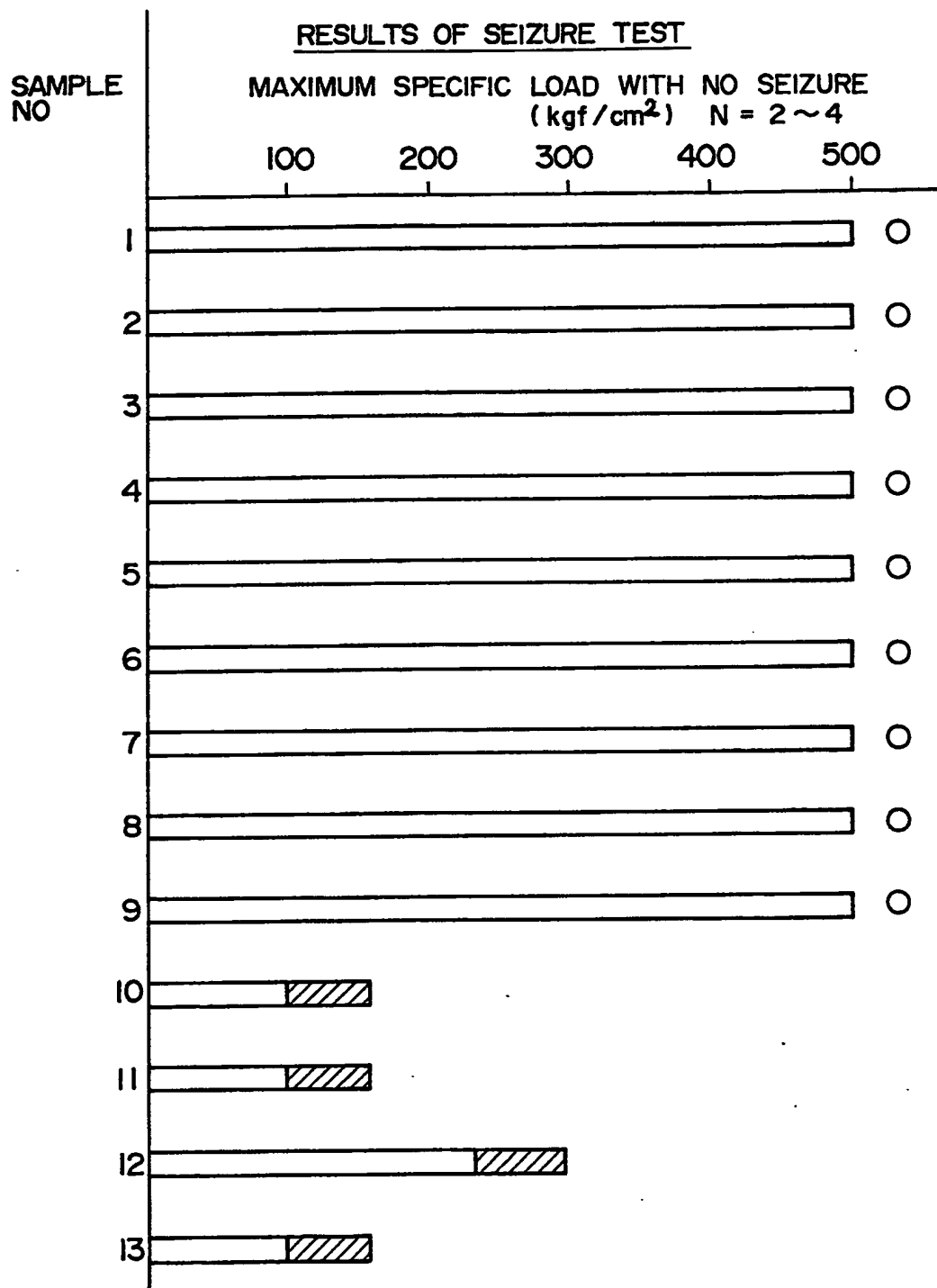
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FIG. 1



EVALUATION METHOD : SEIZURE IS JUDGED WHEN BEARING
BACK TEMPERATURE RISES OVER
200°C, OR FRICTION RESISTANCE
RISES OVER 50 kgf · cm²

FIG. 2



*1: MARKS ○ INDICATE THAT NO SEIZURE WAS OBSERVED
MARKS ▨ INDICATE VARYING RANGES OF TEST RESULTS

*2: SAMPLE NO 1 TO 9 ARE ALLOYS OF INVENTION
SAMPLE NO 10 TO 13 ARE CONVENTIONAL ALLOYS

FIG. 3

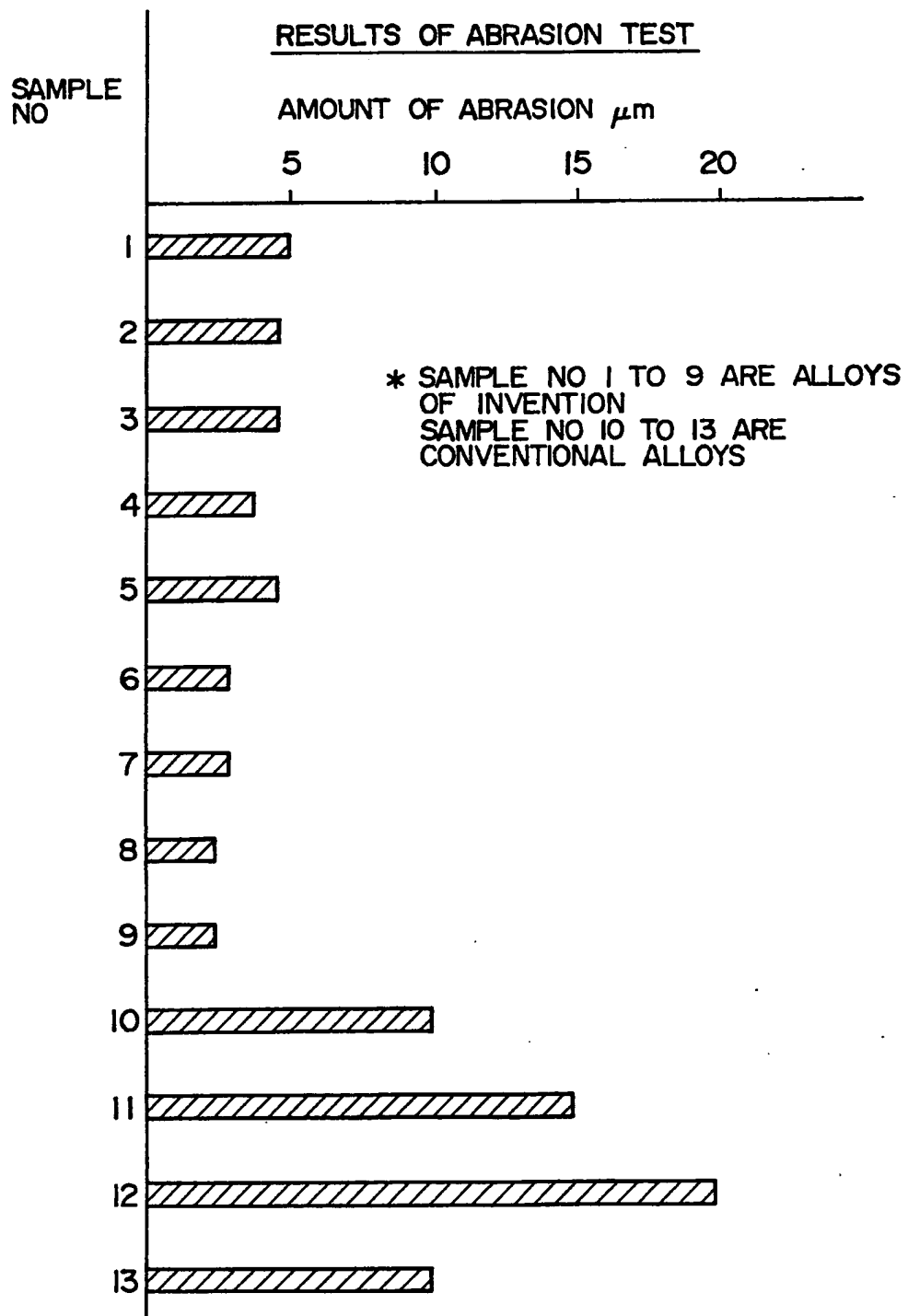


FIG. 4

SAMPLE NO	SURFACE DISCOLORATION	RESULTS OF CORROSION TEST			
		CORROSION AMOUNT (mg/cm ³)		UPPER BAR : 500HR LOWER BAR : 1000HR	
		-1	-2	-3	-4
1	LIGHT BLACK	0.02	500HR. TEST		
		0.03	1000HR. TEST		
3	LIGHT BLACK	0.02	500HR. TEST		
		0.02	1000HR. TEST		
5	NO DISCOLORATION	0	500HR. TEST		
		0.01	1000HR. TEST		
9	NO DISCOLORATION	0	500HR. TEST		
		0.01	1000HR. TEST		
10	LIGHT BLACK	0.03	500HR. TEST		
		0.05	1000HR. TEST		
11	BLACK	0.41	500HR. TEST		
				3.40	1000HR. TEST
12	LIGHT BLACK	0.03	500HR. TEST		
		0.05	1000HR. TEST		

SAMPLE NO 1 TO 9 ARE ALLOYS OF INVENTION
SAMPLE NO 10 TO 13 ARE CONVENTIONAL ALLOYS

BEARINGS

1

2

3 The present invention relates to a copper, e.g. copper
4 based, alloy which may be superior in its resistance to
5 seizure, wear and/or corrosion. The alloy is suitable
6 for use as a material in the manufacture of a sliding
7 member, and particularly sliding members (or bearings)
8 which are used under severe sliding conditions, such as
9 a floating bush bearing of a turbocharger.

10

11 In general, the following materials (1), (2) and (3),
12 all of which are alloys, are known as materials for a
13 floating bush bearing of a turbocharger: (1) a free
14 cutting brass (JIS H3250); (2) a lead-bronze (JIS
15 H5115); and (3) a low-friction high-tension brass which
16 is disclosed in JP-B2-53-44135 and JP-B2-56-11735, both
17 earlier patents in the name of the present applicant.

18

19 However, the above-mentioned alloy (1) is inferior in
20 its resistance to seizure and wear when used under
21 boundary lubricating conditions, and the alloy (2) can
22 not provide sufficiently high resistance to corrosion
23 when used with deteriorated lubricating oil at high
24 temperatures. The alloy (3) does not satisfactorily
25 inhibit high resistance to seizure because of
26 difficulty in enhancing its lead content due to the
27 fact that this alloy has a micro-structure of which
28 matrix is composed of a mixture of α - and β -phases or
29 β -phase alone.

30

31 In recent years, there has been remarkable trend
32 towards supercharged engines, and floating bush
33 bearings which are used in turbochargers that are

1 attached to internal combustion engines are required to
2 operate under more severe conditions such as ambient
3 temperature, rate of supply of the lubricating oil and
4 degradation of lubrication oil.

5
6 Usually a floating bush bearing will be heated to a
7 high temperature, e.g., 400°C or so, due to transfer of
8 heat from a turbine. This means that any sulphur
9 present in a lubricating oil (depending on the nature
10 of the oil and the temperature) tends to react with
11 copper in the bearing metal to form copper sulphide
12 (CuS). This forms a blackened layer, mainly composed
13 of CuS, on the surface of the bearing metal. The
14 blackened layer progressively grows as the bearing is
15 used and then exfoliates from the bearing surface to
16 seriously impair the bearing function of the floating
17 bush bearing.

18
19 Furthermore, conventional bearing materials are not
20 able to provide satisfactory seizure resistance in a
21 dry-up condition, i.e., when lubrication with
22 lubricating oil is stopped at a high temperature, such
23 as 300°C or higher. In more detail, a turbocharger,
24 which comprises a gas turbine impeller driven by the
25 energy of exhaust gases at high temperature and
26 pressure, and a compressor driven by the turbine
27 impeller, has to idle, due to its inertia, even after
28 the engine has been stopped which terminates the supply
29 of pressurised lubricating oil (to the turbocharger).
30 Consequently, the turbocharger is obliged to idle a
31 while without the cooling and lubricating effects
32 produced by the lubricating oil. As a result, heat
33 energy which has been accumulated in the turbine

1 housing, at a high temperature, is transmitted to
2 regions at lower temperatures, thus raising the
3 temperature of the bearing portion. Thus, the bearing
4 should have a high resistance to seizure in dry-up
5 state at high temperatures.

6
7 Hitherto, lead-bronze systems containing copper, lead
8 and tin as main components, and free cutting brass
9 containing copper, zinc and lead as main components
10 have been widely used as the material of the floating
11 bush bearings of turbochargers. However, floating bush
12 bearings of lead-bronze system alloy undesirably
13 promote generation of a blackened layer due to reaction
14 between sulphur in the lubricating oil and copper in
15 the bronze. This occurs under dry-up conditions at
16 high temperature of 300°C or so and leads to a rapid
17 wear of the bearing surface. On the other hand, the
18 free cutting brass system alloys, although they may
19 exhibit superior corrosion resistance, exhibit inferior
20 affinity for lubricating oil after the termination of
21 lubrication, thus resulting in a comparatively early
22 seizure or scuffing.

23
24 Accordingly, one object of the present invention is to
25 provide a novel copper, e.g. copper-based, alloy
26 suitable for use as a material of a sliding member,
27 which may have improved resistance to wear, seizure
28 and/or corrosion and which can withstand use under
29 severe conditions, such as operation at high sliding
30 speeds and high temperatures in highly-corrosive
31 conditions, as typically encountered by turbocharger
32 bearings.

33

1 According to a first aspect of the present invention
2 there is provided a copper alloy comprising from 1.0 to
3 3.5% manganese (Mn), from 0.3 to 1.5% silicon (Si),
4 from 5 to 18% lead (Pb), from 1 to 25% zinc (Zn), the
5 major component being copper. Thus it will generally
6 be copper that is present in the greatest amount in the
7 copper alloy of the present invention. The copper
8 alloy will usually be in the form of a single piece of
9 metal although it is to be understood that other forms
10 of alloys, including powders, are included. All
11 percentages of components of the copper alloy are in
12 terms of weight, unless otherwise stated.

13
14 Usually the balance will be substantially copper, after
15 all of the other components. It will of course be
16 appreciated that there may be some incidental
17 impurities in the copper alloy and therefore the exact
18 balance may not necessarily be copper alone.

19
20 It is preferred that the copper alloy is substantially
21 free of tin.

22
23 Suitably the lead is uniformly distributed throughout
24 the copper alloy. Alternatively or in addition, the
25 alloy has a structure whose matrix is substantially all
26 α -phase. Thus, the alloy preferably has a
27 micro-structure whose matrix is composed of α -phase
28 alone.

29
30 The amount of zinc in the copper alloy is preferably
31 from 10 to 25%, and optimally from 13 to 23%.

32
33 As far as manganese is concerned, this is preferably

1 provided at an amount of from 1.5 to 3.0%. for
2 silicon, the preferred amount in the copper alloy
3 ranges from 0.5 to 1.3%. For lead this range is from 6
4 to 15%.

5
6 It will be appreciated that other elements can be
7 included in the copper alloy. These are preferably
8 metals. Particularly preferred alloy metals include
9 tellurium (Te), magnesium (Mg), nickel (Ni) and/or
10 aluminium (Al). Any combination of these four alloy
11 metals may be used in the copper alloy of the present
12 invention. Thus, only one of the four alloy metals may
13 be used. However, if more than one of these four alloy
14 metals are employed, then preferred combinations
15 include tellurium and nickel; tellurium, nickel and
16 aluminium; and tellurium, nickel, aluminium and
17 magnesium (i.e. all four alloy metals). It will
18 therefore be realised that the copper alloy of the
19 present invention preferably additionally comprises
20 tellurium and/or nickel.

21
22 If magnesium is provided, then it is suitably present
23 at from 0.02 to 1.5%, such as from 0.8 to 1.2%. As far
24 as tellurium is concerned, if this element is present
25 then it is preferred that it is provided at from 0.1 to
26 1.5%, such as from 0.8 to 1.2%.

27
28 If nickel is present, then it is preferred that this is
29 provided at from 0.5 to 3.0% , such as from 1.0 to
30 1.5%. Similarly, if aluminium is present then the
31 amount ranges from 0.3 to 3.0%, such as from 1.0 to
32 1.5%.

33

1 A particularly preferred combination of the four alloy
2 metals is to include one of magnesium or tellurium
3 together with one of nickel or aluminium.

4
5 The manganese may react with the silicon to form the
6 compound Mn_5Si_3 . Thus, although the manganese:silicon
7 ratio may range by as much as from 2:3 to 10:1 (by
8 weight), a preferred weight ratio of Mn:Si is from
9 1:0.1 to 1:0.5, such as from 1:0.2 to 1:0.4.

10

11 The object of the present invention may thus be
12 achieved by any of the following alloys (a) to (d),
13 which are preferred alloys of the present invention.

14

15 (a) A copper based alloy suitable for use as a
16 material of a sliding member, that may be superior in
17 seizure resistance, wear resistance and/or corrosion
18 resistance, the alloy comprising from 1.0 to 3.5 wt% of
19 manganese, from 0.3 to 1.5 wt% of silicon, from 10 to
20 25 wt% of zinc, from 5 to 18 wt% of lead and the
21 balance of the alloy being essentially copper and
22 incidental impurities, the lead being uniformly
23 distributed through the structure of the alloy and the
24 alloy having a micro-structure of which matrix is
25 composed of α -phase alone.

26

27 (b) A copper based alloy suitable for use as a
28 material of a sliding member, that may be superior in
29 seizure resistance, wear resistance and/or corrosion
30 resistance, the alloy comprising from 1.0 to 3.5 wt% of
31 manganese, from 0.3 to 1.5 wt% of silicon, from 10 to
32 25 wt% of zinc, from 5 to 18 wt% of lead, and from 0.02
33 to 1.5 wt% of magnesium or from 0.1 to 1.5 wt% of

1 tellurium (or both), the balance of the alloy being
2 essentially copper and incidental impurities, the lead
3 being uniformly distributed through the structure of
4 the alloy and the alloy having a micro-structure of
5 which matrix is composed of α -phase alone.

6
7 (c) A copper based alloy suitable for use as a
8 material of a sliding member, that may be superior in
9 seizure resistance, wear resistance and/or corrosion
10 resistance, the alloy comprising from 1.0 to 3.5 wt% of
11 manganese, from 0.3 to 1.5 wt% of silicon, from 10 to
12 25 wt% of zinc, from 5 to 18 wt% of lead, and from 0.5
13 to 3.0 wt% of nickel or from 0.3 to 3.0 wt% of
14 aluminium (or both), the balance of the alloy being
15 essentially copper and incidental impurities, the lead
16 being uniformly distributed through the structure of
17 which matrix is composed of α -phase alone.

18
19 (d) A copper based alloy suitable for use as a
20 material of a sliding member, that may be superior in
21 seizure resistance, wear resistance and corrosion
22 resistance, the alloy comprising from 1.0 to 3.5 wt% of
23 manganese, from 0.3 to 1.5 wt% of silicon, from 10 to
24 25 wt% of zinc, from 5 to 18 wt% of lead, and from 0.02
25 to 1.5 wt% of magnesium or from 0.1 to 1.5 wt% of
26 tellurium (or both), and from 0.5 to 3.0 wt% of nickel
27 or 0.3 to 3.0 wt% of aluminium (or both), the balance
28 of the alloy being essentially copper and incidental
29 impurities, the lead being uniformly distributed
30 through the structure of the alloy and the alloy having
31 a micro-structure of which matrix is composed of
32 α -phase alone.

33

1 Reasons for the preferred limitations on the various
2 alloy elements are as follows.

3

4 (1) Zinc (Zn): 1 to 25 wt%

5 Zinc may provide strength and wear resistance, as
6 well as corrosion resistance to the lubricating oil.
7 The preferred amount of this element depends on zinc
8 equivalents of other elements but the amount of zinc is
9 preferably not less than 10 wt% because these
10 properties may not be appreciable when the zinc content
11 is below 10 wt%. The amount of lead (Pb), which
12 conventionally has been added in order to improve
13 seizure resistance, can be undesirably limited if the
14 structure has a mixed phase of α and β . Therefore, as
15 a rule, the alloy of the present invention is suitably
16 a single-phase structure of α -phase. In order to
17 ensure a micro-structure of α -phase alone and allow a
18 minimum amount, e.g., 5 wt%, of lead in the α -phase,
19 the maximum content of zinc is preferably 25% wt.

20

21 (2) Manganese (Mn): 1.0 to 3.5 wt%

22 Manganese can react with silicon (Si) so as to
23 form the intermetallic compound Mn_5Si_3 which may have
24 superior sliding characteristics, and may thus
25 contribute to improvements in wear resistance and
26 seizure resistance, while preventing any plastic flow
27 of the matrix in the event of a metal-to-metal contact.
28 In order to obtain an appreciable effect, the manganese
29 is suitably present at at least 1.0 wt%. Any
30 manganese content exceeding 3.5 wt%, on the other hand,
31 may cause a saturation of the effect and, more
32 importantly, undesirably embrittle the alloy.

33

1 (3) Silicon (Si): 0.3 to 1.5 wt%

2 As discussed, silicon reacts with manganese to
3 form the intermetallic compound Mn_5Si_3 which can
4 contribute to any improvement in the wear resistance
5 and seizure resistance. The content of silicon is
6 usually determined in accordance with the desired
7 amount of Mn_5Si_3 to be obtained. All the silicon can
8 be converted into this compound when the ratio of
9 manganese to silicon is 1:0.3 in terms of weight.
10 Thus, preferred minimum silicon content should be 0.3
11 wt%. Addition of silicon in excess of the upper limit
12 value of 1.5 wt% may result in an excessive
13 crystallisation of free silicon, causing embrittlement
14 of the alloy.

15

16 (4) Lead (Pb): 5 to 18 wt%

17 Lead usually has a self-lubricating property and
18 can easily be made molten by frictional heat so
19 spreading over the sliding surface to form a thin film
20 of several microns thick. This can remarkably improve
21 seizure resistance and may also attain a good machining
22 property. In order to form the thin film of lead of
23 several microns thick, the lead content is suitably at
24 least 5 wt%. An increase in the lead content, on the
25 other hand, may cause a reduction in the strength of
26 the alloy, so that the maximum lead content is
27 preferably set at 18 wt%. The lead content, therefore,
28 is suitably in the range of from 5 to 18 wt%.

29

30 (5) Magnesium (Mg): (optionally) 0.02 to 1.5 wt%

31 Magnesium can be effective in uniformly dispersing
32 lead and also in strengthening the matrix. These
33 effects may not be appreciable if the magnesium content

1 falls below 0.02 wt%. Addition of magnesium in excess
2 of 1.5 wt%, may on the other hand, cause an excessive
3 crystallisation of an intermetallic compound of
4 magnesium and lead, thus impairing the lubricating
5 effect produced by the lead. For these reasons, the
6 content of magnesium is preferably limited to range
7 from 0.02 wt% to 1.5 wt%.

8
9 (6) Tellurium (Te): (optionally) 0.1 to 1.5 wt%

10 The presence of a small amount of tellurium may
11 promote uniform dispersion of lead and improve
12 toughness and seizure resistance, as well as corrosion
13 resistance, of the alloy. These effects, however, may
14 not be appreciable if the tellurium content is below
15 0.1 wt%. On the other hand, addition of tellurium in
16 excess of 1.5 wt% may cause a substantial saturation of
17 the effect while raising the cost uneconomically. The
18 amount of addition of tellurium, therefore, is suitably
19 provided to range from 0.1 to 1.5 wt%.

20
21 (7) Nickel (Ni): (optionally) 0.5 to 3.0 wt%

22 Nickel may strengthen the matrix so as to improve
23 the strength of the alloy while enhancing wear
24 resistance. Nickel may also raise the
25 recrystallisation temperature so as to prevent
26 coarsening of the crystal grains during hot plastic
27 working. These effects, however, may not be noticeable
28 when the nickel content is below 0.5 wt%. On the other
29 hand, addition of nickel in excess of 3 wt% may, in
30 some circumstances, seriously impair fatigue strength
31 and impact resistance of the alloy. For these reasons,
32 the nickel content preferably ranges from 0.5 to 3.0
33 wt%.

1
2 (8) Aluminium (Al): (optionally) 0.3 to 3.0 wt%

3 Aluminium may also contribute to strenghtening of
4 the matrix. This effect, however, may not be
5 appreciable if the aluminium content is below 0.3 wt%.
6 On the other hand, an aluminium content exceeding 0.3
7 wt% may undesirably cause embrittlement and coarsening
8 of the crystal grains. For these reasons, the
9 aluminium content preferably ranges from 0.3 to 3.0
10 wt%.

11
12 A second aspect of the present invention relates to a
13 process for the preparation of a copper alloy
14 comprising from 1.0 to 3.5% manganese, from 0.3 to 1.5%
15 silicon, from 5 to 18% lead, from 1 to 25% zinc, the
16 major component being copper, the process comprising
17 admixing the components.

18
19 Here the term "components" refers not only to the
20 manganese, silicon, lead, zinc and copper, but any
21 other ingredients (whether other elements, such as
22 alloy metals, or compounds). It will be appreciated
23 that the process includes not only the process of
24 mixing all of the components simultaneously, but also
25 includes a process whereby two or more of the
26 components are admixed before further mixing with any
27 or all of the remaining components. Processes for
28 making the copper alloys of the present invention will
29 be known by those skilled in the art.

30
31 Preferred features and characteristics of the second
32 aspect are as for the first aspect *mutatis mutandis*.

33

1 A third aspect of the present invention relates to a
2 sliding member comprising a copper alloy of the first
3 aspect. The sliding member will usually be a bearing.
4 Often the sliding member will be present in a
5 supercharger, such as a turbocharger.

6
7 Thus, according to a fourth aspect of the present
8 invention there is provided a supercharger which is
9 provided with a sliding member of the third aspect.
10 The supercharger will generally be a turbocharger.

11
12 Preferred features and characteristics of the third and
13 fourth aspects are as for the first and second aspects
14 *mutatis mutandis*.

15
16 Several examples of the alloy of the present invention,
17 which are provided for means of illustration, will now
18 be described with reference to the accompanying
19 drawings, in which:

20
21 Figure 1 is a graph of load against time illustrating
22 the procedure of a seizure resistance test used to test
23 prior art alloys and alloys of the present invention
24 (also referenced in Table 4);

25
26 Figure 2 is a bar chart illustrating the results of the
27 seizure resistance test on prior art alloys and alloys
28 of the present invention;

29
30 Figure 3 is a second bar chart showing the results of a
31 wear resistance test on prior art alloys and alloys of
32 the present invention; and
33

1 Figure 4 shows the results of a corrosion resistance
2 test on prior art alloys and alloys of the present
3 invention.

4

5 The invention will now be describes by way of example,
6 with reference to the accompanying Examples which are
7 provided for means of illustration and are not to be
8 construed as being limiting.

9

10 Examples 1 to 9 (Alloys of the Present Invention)

11

12 Alloys of compositions nos. 1 to 9 shown in Table 1
13 were prepared by continuous casting process and were
14 formed into bars of 35 mm diameter through extrusion
15 and drawings. (Alloy no. 9 contained 18% zinc). The
16 bars were suitably worked to provide test pieces for a
17 seizure test, abrasion test and a corrosion test.

18

19 The conditions of the tests conducted on these test
20 pieces are shown in Tables 2 to 4 and Figure 1. The
21 results of the seizure test and the abrasion test are
22 shown in Figure 2, Table 5 and in Figure 3
23 respectively. Representative data of the results of
24 the corrosion test is shown in Figure 4.

25

26 Comparative Examples 10 to 13 (Conventional Alloy)

27

28 Conventional alloys of compositions nos. 10 to 13, as
29 shown in Table 1, were formed into bars of 35 mm
30 diameter through continuous casting, extrusion and
31 drawing. These bars were subjected to the same tests
32 as those for the test pieces of Examples 1 to 9. The
33 conditions of these tests are shown in Tables 2 to 4

1 and Figure 1, while the test results are shown in
2 Figures 2 to 4 and Table 5.

3

4 Although the tests were conducted on the alloy bars
5 which were produced through continuous casting, it is
6 to be understood that the same advantages are obtained
7 with test pieces of alloys formed by a different
8 casting method, such as stationary casting.

9

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Table 1

Class	Sample No.	Composition (wt%)										Mechanical Property			
		Cu	Zn	Pb	Mn	Si	Te	Mg	Al	Ni	Sn	Fe	Tensile Strength (Kgf/mm ²)	Elongation (%)	Hardness (HV10)
Alloy of The Present Invention	1	Bal.	18	6	2.5	1.0							28.3	7.4	104
	2	Bal.	20	15	2.0	0.7							27.0	7.0	105
	3	Bal.	15	6	3.0	1.3	1.0						29.0	9.0	110
	4	Bal.	23	13	2.0	1.0		1.0					29.5	10.0	106
	5	Bal.	15	6	1.5	0.5				1.0			32.0	9.0	115
	6	Bal.	18	15	2.0	1.0			1.0				31.5	8.0	110
	7	Bal.	13	13	2.0	0.8	1.0			1.0			30.0	9.0	112
	8	Bal.	23	15	2.0	0.8	1.0		1.5	1.0			34.0	10.0	110
	9	Bal.	1.8	6	1.5	0.5	1.0	1.0	1.0	1.5			37.0	11.0	125
Conventional Alloy	10	59	Bal.	3									41.3	32.2	128
	11	Bal.		15							8		29.3	12.6	87
	12	58	Bal.		1.5				1.0			0.5	61.0	27.0	140
	13	Bal.	34.1	4	3.0	1.2	0.4		1.3				55.0	25.0	151

Table 2

Abrasion test		
Testing Condition	Value	Unit
1. Testing Machine	Bush Tester	
2. Bush Size	Ø20 x Ø23 x L20	mm
3. Rotation Speed	3,000	rpm
4. Circumferential Speed	3.14	m/s
5. Surface Pressure (projected)	10	kgf/cm ²
6. Clearance (Diameter)	0.08~0.10	mm
7. Lubricant	10	OC/min
8. Temperature	150	°C
9. Shaft Material	S55C	-
Roughness	1.0	Rmax µm
Hardness	500~600.	Hv 10kg
10. Time	100	hour

Table 3

Corrosion test	
Testing Condition	
Oil	Immersing in Turbo Lubricating Oil (equivalent to 15 W-40).
Test Temperature	130°C
Test Time	500 Hr, 1000 Hr

Table 4

Seizure test		
Testing Condition	Value	Unit
1. Testing Machine	Suzuki-type Tester	
2. Bearing Size	Ø25 x Ø21.7 OD x ID	mm
3. Rotation Speed	1055	rpm
4. Circumferential Speed	1.29	m/s
5. Lubricant	SAE 30	-
6. Lubricating Method	Oil Bath	-
7. Lubricant Temperature	Room Temperature	°C (at starting time)
8. Shaft Material	S55C	
Roughness	0.3	Rmax µm
Hardness	500~600	Hv 10kg

Table 5

Class	Sample No.	Results of Test on Actual Turbocharger (Oil ON-OFF Test at Predetermined Speed)
Alloy of The Present Inven- tion	1	3000 cycle OK
	2	"
	3	"
	4	"
	5	"
	6	"
	7	"
	8	"
	9	"
Conven- tional Alloy	10	Seizure occurred in 2nd cycle
	11	Seizure occurred in 5th cycle
	12	Seizure occurred in 10th cycle
	13	Seizure occurred in 10th cycle

1

2 **Evaluation of Test results**

3

4 (1) From the comparison of the results of the seizure
5 test whose conditions are shown in Figure 2, it will be
6 seen that the alloys of the present invention can be
7 used without risk of seizure up to the maximum load of
8 500 kgf/cm², which should be contrasted to the
9 conventional prior art free cutting brass (No. 10) and
10 high-strength brass (nos. 12 and 13).

11

12 (2) The alloys of the present invention did not
13 show any seizure in the seizure test over a specific
14 number of revolutions in an actual machine which
15 incorporated a bearing made of the alloy to be tested.
16 The supply of lubricating oil to the machine was turned
17 on and off, as shown in Table 5. The alloys of the
18 present invention exhibited superior performance, as a
19 sliding material, over prior art alloys, thus giving a
20 satisfactory and acceptable result when used as the
21 material of a floating bush bearing.

22

23 (3) As will be seen from Figure 3, which shows the
24 result of the abrasion test, the alloys in accordance
25 with the present invention showed less wear than
26 conventional prior art alloys, demonstrating superior
27 wear resistance. The abrasion test was conducted in a
28 wet process using a lubricating oil, while employing a
29 quench-hardened bearing made of JIS S55C as the mating
30 (or opposed) sliding member.

31

32 (4) The alloys in accordance with the present
33 invention were also superior in corrosion resistance

1 than conventional prior art alloys as will be seen from
2 the results shown in Figure 4.

3
4 Thus, the copper alloys of the present invention may be
5 superior in seizure resistance, wear resistance and/or
6 corrosion resistance compared with conventional alloys.
7 These characteristics can offer remarkable advantages,
8 particularly when the alloy of the present invention is
9 used as a material in a sliding member. Such sliding
10 members are often required to have an improved
11 performance and life, for example in turbochargers.

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CLAIMS

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3 1. A copper alloy comprising from 1.0 to 3.5%
4 manganese, from 0.3 to 1.5% silicon, from 5 to 18%
5 lead, from 1 to 25% zinc, the major component being
6 copper.
7
- 8 2. An alloy as claimed in claim 1 when the balance is
9 substantially copper.
10
- 11 3. An alloy as claimed in claim 1 or 2 wherein the
12 zinc is present at from 10 to 15%.
13
- 14 4. An alloy as claimed in any of claims 1 to 3
15 wherein the lead is uniformly distributed in the alloy.
16
- 17 5. An alloy as claimed in any of claims 1 to 4 which
18 has a micro-structure whose matrix is substantially
19 only α -phase.
20
- 21 6. An alloy as claimed in any of claims 1 to 5
22 wherein the manganese is at from 1.5 to 3.0%.
23
- 24 7. An alloy as claimed in any of claims 1 to 6
25 wherein the silicon is present at from 0.5 to 1.3 %.
26
- 27 8. An alloy as claimed in any of claims 1 to 7
28 wherein the zinc is present at from 13 to 23%.
29
- 30 9. An alloy as claimed in any of claims 1 to 8
31 wherein the lead is present at from 6 to 15%.
32
- 33 10. An alloy as claimed in any of claims 1 to 9

- 1 additionally comprising one of the four alloy metals
2 tellurium, magnesium, nickel and/or aluminium.
3
- 4 11. An alloy as claimed in claim 10 which additionally
5 comprises only one of tellurium, magnesium, nickel or
6 aluminium.
7
- 8 12. An alloy as claimed in claim 10 additionally
9 comprising one of magnesium or tellurium together with
10 one of nickel or aluminium.
11
- 12 13. An alloy as claimed in any of claims 10 to 12
13 additionally comprising tellurium and/or nickel.
14
- 15 14. An alloy as claimed in any of claims 10 to 13
16 additionally comprising tellurium and nickel, tellurium
17 nickel and aluminium, or tellurium nickel aluminium and
18 magnesium.
19
- 20 15. An alloy as claimed in any of claims 10 to 14
21 wherein the magnesium is present at from 0.02 to 1.5%.
22
- 23 16. An alloy as claimed in any of claims 10 to 15
24 wherein the tellurium is present at from 0.1 to 1.5%.
25
- 26 17. An alloy as claimed in any of claims 1 to 15
27 wherein the nickel is present at from 0.5 to 3.0%.
28
- 29 18. An alloy as claimed in any of claims 1 to 15
30 wherein the aluminium is present at from 0.3 to 3.0%.
31
- 32 19. An alloy as claimed in any of claims 1 to 18
33 wherein the weight ratio of manganese:silicon is from

- 1 1:0.1 to 1:0.5.
2
3 20. An alloy as claimed in any of claims 1 to 19
4 wherein the ratio of manganese:silicon is from 1:0.2 to
5 1:0.4.
6
7 21. A process for the preparation of a copper alloy
8 comprising from 1.0 to 3.5% manganese, from 0.3 to 1.5%
9 silicon, from 5 to 18% lead, from 1 to 15% zinc, the
10 major component being copper, the process comprising
11 admixing the components.
12
13 22. A process as claimed in claim 21 for preparing a
14 copper alloy as claimed in any of claims 1 to 20.
15
16 23. A sliding member comprising a copper alloy as
17 claimed in any of claims 1 to 20.
18
19 24. A sliding member as claimed in claim 23 which is a
20 bearing.
21
22 25. A sliding member as claimed in claim 23 or 24
23 which is a supercharger bearing.
24
25 26. A sliding member as claimed in any of claims 23 to
26 25 which is a turbocharger bearing.
27
28 27. A supercharger provided with a sliding member as
29 claimed in any of claims 23 to 26.
30
31 28. A supercharger as claimed in claim 27 which is a
32 turbocharger.
33

1 29. A copper alloy substantially as herein described
2 with reference to the Examples, but without reference
3 to the Comparative Examples.

4

5 30. A bearing substantially as herein described with
6 reference to the Examples, but without reference to the
7 Comparative Examples.

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PAT-NO: GB002240785A

DOCUMENT-IDENTIFIER: GB 2240785 A

TITLE: Bearings

PUBN-DATE: August 14, 1991

INVENTOR-INFORMATION:

NAME	COUNTRY
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ASSIGNEE-INFORMATION:

NAME	COUNTRY
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APPL-NO: GB09101342

APPL-DATE: January 22, 1991

PRIORITY-DATA: JP01055690A (January 22, 1990)

INT-CL (IPC): C22C009/08

EUR-CL (EPC): C22C009/04 ; F16C033/12

ABSTRACT:

CHG DATE=19940730 STATUS=O> A copper based alloy, suitable for use in a bearing, is disclosed that can have improved resistance, wear resistance and corrosion resistance. The copper alloy comprises from 1.0 to 3.5 wt% Mn, 0.3 to 1.5 wt% Si, 1 to 25 wt% Zn, 5 to 18 wt% Pb, the balance being substantially Cu (and any incidental impurities). The lead is uniformly distributed throughout the structure of the alloy. The alloy has a microstructure whose matrix is composed of alpha -phase alone. The alloy can further contain at least one alloy metal from 0.02 to 1.5 wt% Mg or 0.1 to 1.5 wt% To and one of 0.5 to 3.0 wt% Ni or 0.3 to 3.0 wt% Al.

DERWENT-ACC-NO: 2002-715372

DERWENT-WEEK: 200280

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TITLE: Composite sliding material for bearing used in automobiles, machines,
comprises sintered copper alloy layer comprising preset amounts of tin,
bismuth, solid lubricant, optionally e.g. iron, bonded to steel plate

INVENTOR: INOUE, E; KURIMOTO, S ; SAKAI, K ;
SHIBAYAMA, T ; YAMAMOTO, K

PATENT-ASSIGNEE: DAIDO METAL CO LTD[DAME],
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PRIORITY-DATA: 2001JP-0084916 (March 23, 2001)

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006	C22C 009/02	

A October 9, 2002 N/A 023
F16C 033/12
GB 2374086 A

APPLICATION-DATA:

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GB 2374086A	N/A	2002GB-0005118
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INT-CL (IPC): B22F007/00; B22F007/04 ; C10M103/00
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C10M103/06 ; C10M125/04 ; C10M169/04 ; C10N010:02 ;
C10N010:04 ;
C10N010:06 ; C10N010:08 ; C10N010:10 ; C10N010:12 ;
C10N010:14 ;
C10N010:16 ; C10N030:06 ; C10N030:18 ; C10N040:02 ;
C10N050:08 ;
C22C001/10 ; C22C009/00 ; C22C009/02 ; F16C033/10 ;
F16C033/12

ABSTRACTED-PUB-NO: GB 2374086A

BASIC-ABSTRACT: NOVELTY - Composite sliding material
comprises a sintered
copper alloy layer bonded to a steel plate. The copper alloy

essentially
comprises (in mass%) tin (1.5-15), bismuth (1.5-15), solid
lubricant (1.5-20
volume%), optionally iron, aluminum, zinc, manganese,
cobalt, nickel, and/or
silicon (not more than 40), balance copper and impurities.
The volume ratio of
bismuth to the solid lubricant is 0.5-20.

USE - For bearing materials used in automobiles,
agricultural machines,
industrial machines.

ADVANTAGE - Tin and phosphorus strengthen the copper
matrix of the copper
alloy. Bismuth liquefies during sintering and improves
sintering property of
the copper alloy including anti-seizure property and wear
resistance of the
copper alloy in oil lubricating and non-lubricating regions.
Bismuth together
with the solid lubricant improve machinability of the sliding
material. The
copper plating layer improves bonding strength between
the sintered copper
alloy layer and the steel plate. The copper system
composite sliding material

without lead, having excellent sliding property equal to or superior to those of lead-bronze system sintered copper alloy and excellent mechanical strength, is provided.

DESCRIPTION OF DRAWING(S) - The figure shows the schematic sectional view of the sintered copper alloy metal structure.

CHOSEN-DRAWING: Dwg.1/2

TITLE-TERMS:

COMPOSITE SLIDE MATERIAL BEARING AUTOMOBILE
MACHINE COMPRISE SINTER COPPER
ALLOY LAYER COMPRISE PRESET AMOUNT TIN
BISMUTH SOLID LUBRICATE OPTION IRON BOND
STEEL PLATE

DERWENT-CLASS: H07 M26 Q62

CPI-CODES: H07-D; M26-B03; M26-B03B; M26-B03J;
M26-B03M; M26-B03N; M26-B03Z;

SECONDARY-ACC-NO:

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